BRITISH STEEL CASTINGS
RESEARCH ASSOCIATION

BROOMGROVE LODGE · SHEFFIELD 10

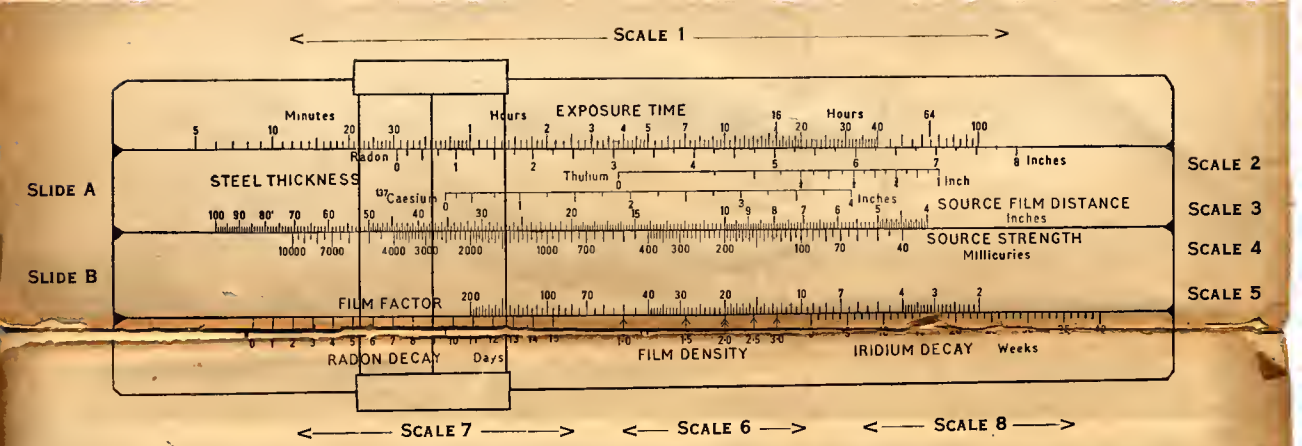
EXPOSURE CALCULATOR FOR GAMMA RADIOGRAPHY

MARK II (inches scale) and MARK III (metric scales)
for use with sources of
^{60}cobalt, ^{192}iridium, ^{137}caesium, ^{170}thulium and radon

Since preparation of these scales, the calibration of Iridium sources has been altered. They are now rated at 54% of their previous value, which means that exposure times as indicated by the calculator must now be reduced by 54%.

All export enquiries should be addressed to

M. FALK & CO. LTD.
5 Victoria Street, London, S.W.1, England
Telephone: Abbey 3197 Cables: Monkee London



INSTRUCTIONS FOR USE

1. TO DETERMINE EXPOSURE TIME (for a given Source to Film Distance).

(a) Insert the upper reversible slide A so that the STEEL THICKNESS scale (2) appropriate to the source in use is on the uppermost face of the calculator. (The cobalt and iridium scales are on one face of slide A; the radon, thulium* and caesium scales are on the reverse side.)

(b) Determine the FILM FACTOR appropriate to the X-ray film in use. (See Table overleaf.)

(c) Move the lower slide B so that the appropriate FILM FACTOR, scale (5), is brought into line with the desired FILM DENSITY, scale (6). (For most routine industrial work, a film density of 1.5 will be found adequate.)

(d) Move the cursor to the point on the SOURCE STRENGH, scale (4), appropriate to the value of the radiation source in use.†

(e) Move the upper slide A so that the chosen SOURCE FILM DISTANCE, scale (3), comes under the line on the cursor.

(f) Reset the upper slide A so that the appropriate STEEL THICKNESS, scale (2), to the point denoting the thickness of steel to be radiographed.

(g) Read off the EXPOSURE TIME, scale (1), indicated by the new position of the cursor.

2. TO DETERMINE SOURCE TO FILM DISTANCE (for a given Exposure Time).

(a) Repeat operation 1 (a), (b) and (c) above.

(b) Move the cursor to the point on the EXPOSURE TIME scale (1) corresponding to the chosen exposure period. [The usual overnight and week-end exposure periods are marked in red on the EXPOSURE TIME scale (1) by the figures 16 and 64 (hours) respectively.]

(c) Move the upper slide A so that the thickness of steel to be radiographed, read off on the appropriate STEEL THICKNESS scale (2), comes under the line on the cursor.

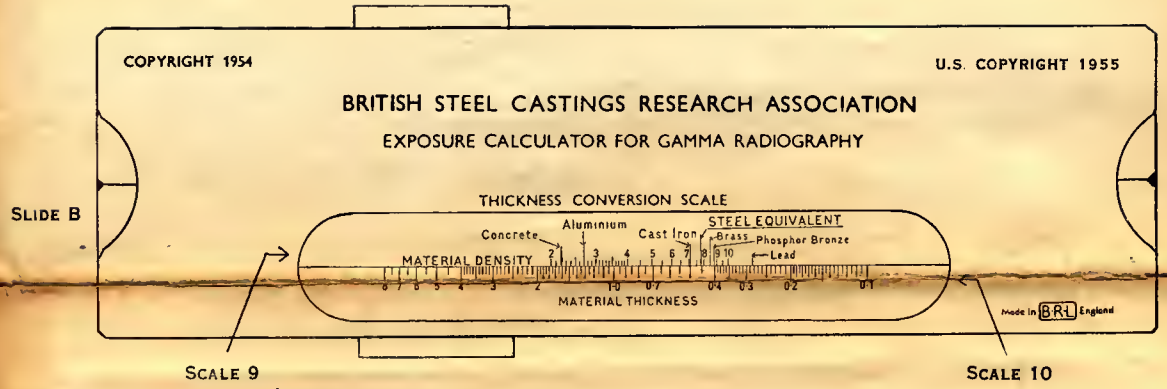
(d) Reset the cursor to the point on the SOURCE STRENGTH scale (4) appropriate to the strength of the source in use.

(e) Read off the SOURCE FILM DISTANCE, scale (3), indicated by the new position of the cursor.

* The ^{170}thulium scale has been calibrated using a 2×2 mm. source. When using the larger 4×4 mm. source, due to a difference in the quality of the radiation, an exposure time differing slightly from that indicated by the Calculator may be found necessary when radiographing very thin sections.

† It should be noted that inconsistencies have arisen in the calibration of ^{137}caesium sources. When using any given source of this isotope therefore, this point should be borne in mind, and if the results obtained with the Calculator are found to be incorrect, it may be necessary to employ on the SOURCE STRENGTH scale (4), a figure differing slightly from the calibrated value.

See also overleaf.



3. TO DETERMINE THE DECAYED STRENGTH OF RADON OR IRIDIUM SOURCES.

(a) Move the cursor to the figure 0 on the appropriate decay scale (7) or (8).

(b) Move the lower slide B so that the figure corresponding to the initial SOURCE STRENGTH, scale (4), comes under the line on the cursor.

(c) Reset the cursor to the point on the appropriate decay scale, (7) or (8), corresponding to the time interval which has elapsed since the source strength was initially determined.

(d) Read off the decayed SOURCE STRENGTH, scale (4), indicated by the new position of the cursor.

4. TO DETERMINE THE EQUIVALENT STEEL THICKNESS TO BE EMPLOYED (Scale 2) WHEN EXAMINING MATERIALS OTHER THAN STEEL.§

(a) Using the THICKNESS CONVERSION scales (9) and (10) on the back of the Calculator, adjust slide B so that the index mark or density value on the MATERIAL DENSITY scale (9) appropriate to the material in question, is brought into line with the thickness of the section to be radiographed, read off on the MATERIAL THICKNESS scale (10).‡

(b) Read off on the MATERIAL THICKNESS scale (10) the equivalent thickness of steel indicated by the point marked STEEL EQUIVALENT on scale (9).

§ USE OF THULIUM WITH LIGHT ALLOYS. When using the isotope ^{170}thulium for the examination of aluminium base alloys or other low density materials, the THICKNESS CONVERSION Scale should not be used.

‡ The MATERIAL THICKNESS scale (10) is engraved in arbitrary units of length. The thickness conversion is, however, most conveniently carried out using the units in which the STEEL THICKNESS scales (2) are graduated (i.e., inches on the Mark II Calculator and centimetres on the Mark III Calculator).

TABLE OF FILM FACTORS

X-Ray Film		Film Factor based on Development Time of:	
Make	Type	5 min. at 68°F.	8 min. at 68°F.
Ilford	Industrial G	9	7
	„ B	19	14
	„ C	108	70
	„ F	180	120
Kodak	Kodirex	8	6.5
	Industrex D	19	14
	Crystallex	55	40
Eastman Kodak	M	158	116
	A	49	40
	F	20	18
	K	8	6.5
	No-screen	13	11
	Blue brand	20	18
Gevaert	Structurix D10	16	12
	„ D 7	67	47

NOTES

(1) The FILM FACTORS quoted in the above Table are given for guidance only, and it should be appreciated that the effective speed of any given film may show some batch to batch variation, and will to some extent depend upon the conditions of development employed. Furthermore, increases in film speed may from time to time be announced by the manufacturers.

Experience will however soon indicate whether, and by how much, the above FACTORS have to be modified to meet any given set of conditions.

(2) The FILM FACTORS are based upon the use of lead screens of the following thicknesses:

Screen	*Cobalt, Iridium and Radon*	*Thulium*
Front	.004 inch	.0015 inch
Back	.010 inch	.0040 inch

The increase in exposure required with thicker front screens (up to .010 inch in the case of cobalt, iridium and radon exposures, and up to .004 inch in the case of thulium exposures) is negligible, and in practice may be ignored.

(3) FACTORS are quoted for development of 5 and 8 minutes at 68°F., using either Kodak D.19b, Ilford ID.19, or Eastman Kodak Rapid X-Ray Developer in the case of the Eastman Kodak films. The effective increase in speed consequent upon the use of the longer development time is frequently taken advantage of, especially when using the slower, fine grain type of film.